

Photocatalytic removal of *Escherichia coli* from aquatic solutions using synthesized ZnO nanoparticles: a kinetic study

Mohammad-Yousef Alikhani, Seung-Mok Lee, Jae-Kyu Yang, Mehdi Shirzad-Siboni, Hadi Peeri-Dogaheh, Masoud-Seyedin Khorasani, Mohammad-Ali Nooshak and Mohammad-Reza Samarghandi

ABSTRACT

Development of effective and low-cost disinfection technology is needed to address the problems caused by an outbreak of harmful microorganisms. In this work, an effective photocatalytic removal of Gram-negative bacteria *Escherichia coli* from aqueous solution was reported by using ZnO nanoparticles under UV light irradiation. The effect of various parameters such as solution pH, ZnO dosage, contact time and initial *E. coli* concentration were investigated. Maximum photocatalytic disinfection was observed at neutral pH because of the reduced photocatalytic activity of ZnO at low and high pH values originated from either acidic/photochemical corrosion of the catalyst and/or surface passivation with $\text{Zn}(\text{OH})_2$. As the ZnO dosage increased, the photocatalytic disappearance of *E. coli* was continuously enhanced, but was gradually decreased above 2 g/L of ZnO due to the increased blockage of the incident UV light used. The optimum ZnO dosage was determined as 1 g/L. Photocatalytic removal of *E. coli* decreased as initial *E. coli* concentration increased. Three kinetic models (zero-, first- and second-order equations) were used to correlate the experimental data and to determine the kinetic parameters.

Key words | disinfection, *Escherichia coli*, photocatalysis, synthesis, ZnO

Mohammad-Yousef Alikhani

Research Center for Health Science,
Hamadan University of Medical Science,
Hamadan,
Iran

Mohammad-Yousef Alikhani Masoud-Seyedin Khorasani

Department of Microbiology,
Faculty of Medicine,
Hamadan University of Medical Science,
Hamadan,
Iran

Seung-Mok Lee

Department of Environmental Engineering,
Kwangdong University, Gangneung,
Korea

Jae-Kyu Yang

Division of General Education,
Kwangwoon University, Seoul,
Korea

Mehdi Shirzad-Siboni (corresponding author)

Department of Environmental Health Engineering,
School of Public Health,
Guilan University of Medical Sciences, Rasht,
Iran
E-mail: mehdi_dshirzad@yahoo.com

Hadi Peeri-Dogaheh

Department of Microbiology,
Faculty of Medicine,
Ardabil University of Medical Science, Ardabil,
Iran

Mohammad-Ali Nooshak

Department of Microbiology,
Faculty of Medicine,
Kurdistan University of Medical Science, Sanandaj,
Iran

Mohammad-Reza Samarghandi

Department of Environmental Health and Research
Center for Health Science,
Hamadan University of Medical Science,
Hamadan,
Iran

INTRODUCTION

Rapid industrialization and urbanization cause contamination of a lot of water resources by discharging wastewater containing organics, microorganisms and

metallic elements (Christensen *et al.* 2003). Wastewaters usually contain high levels of microorganisms. Therefore disinfection is an important and essential aspect of